Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

SOME STRATIGRAPHIC AND STRUCTURAL FEATURES OF THE PRE-CAMBRIAN OF NORTHERN QUEBEC

H. C. COOKE
Geological Survey of Canada, Ottawa

PART II

DETAILED AREAL DESCRIPTIONS

In the following descriptions the structures of the separate areas studied will be briefly stated, with the conclusions as to succession which were made in each area. Fig. 3 shows the relative positions of the areas described. In the Opawika, Father's Lake, Windy Lake, and Eau Jaune–Obatogamau areas, where the rocks are largely of the basal lava series, or Abitibi volcanics, the determinations of the structure were in each case the result of a large number of observations, using the methods described, on the attitude of the lava flows over as wide an area as the nature of the work permitted. The results of each determination by any one of the methods described were checked whenever possible by the application of one or more of the other criteria as well. No other stratigraphic methods were applied or, in fact, were applicable. For the sake of brevity, therefore, the methods of determination of the structure in the separate instances will not be stated, as this would only involve unnecessary repetition.

The Opawika area.—The Opawika area (Fig.4) borders the Opawika River near its junction with the Waswanipi River. It includes the northern portion of Tush Lake, Opawika Lake, and the Opawika River from Opawika Lake down to Sturgeon fall. The rocks are a series of closely folded lavas and tuffs and are unusually well exposed. The axes of the folds strike N. 75° E., but their plunge was not determined. The approximate position of these axes is shown on the map. The southernmost fold, on Tush Lake, is an anticline, the southern limb of which is cut off by granite. The axis of the syncline to the north follows approximately the south shore of Opawika Lake. The west end of the lake breaks across into the next anticline to the north.

The rocks in the southern anticline are andesites, fairly massive and without pillow structures. Dips vary from 65° to 90°. On the north side of this anticline, in the long east bay of Tush Lake, coarse andesitic tuffs lie conformably on the andesites. They are not bedded.

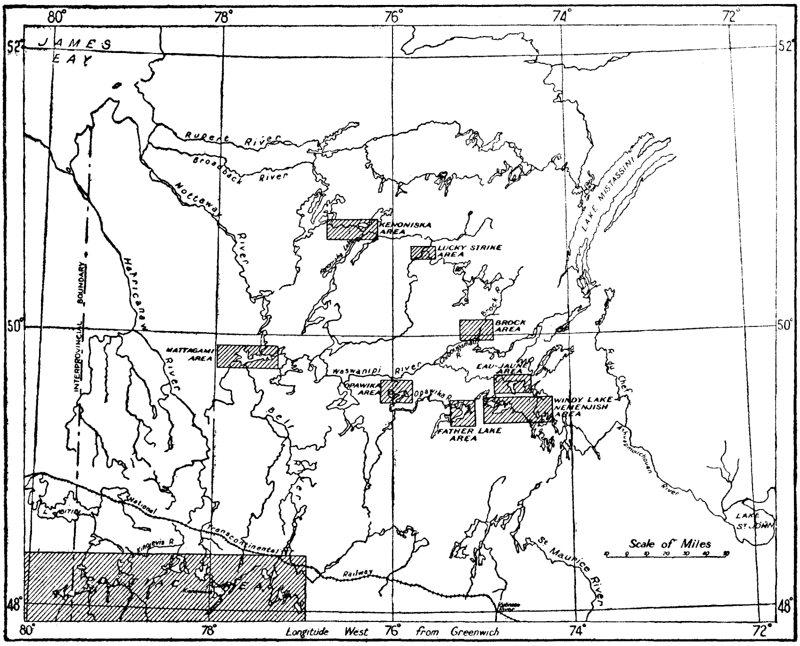

Fig. 3.—Key map of the part of northern Quebec dealt with in this paper, and the positions of the small areas particularly described.

Along the axis of the syncline, on the south shore of the western end of Opawika Lake, a flow of highly acid quartz porphyry, a translucent, greenish-white rock, conformably overlies the andesite. In the anticline to the north, lavas of acidity intermediate between the quartz porphyry and the andesite outcrop until the normal andesite is again reached. The latter continues to outcrop as far as Sturgeon fall.

The succession in this area is:

Rhyolite porphyry lavas
Intermediate lavas
Andesites and andesite tuffs at or near the top of the flows

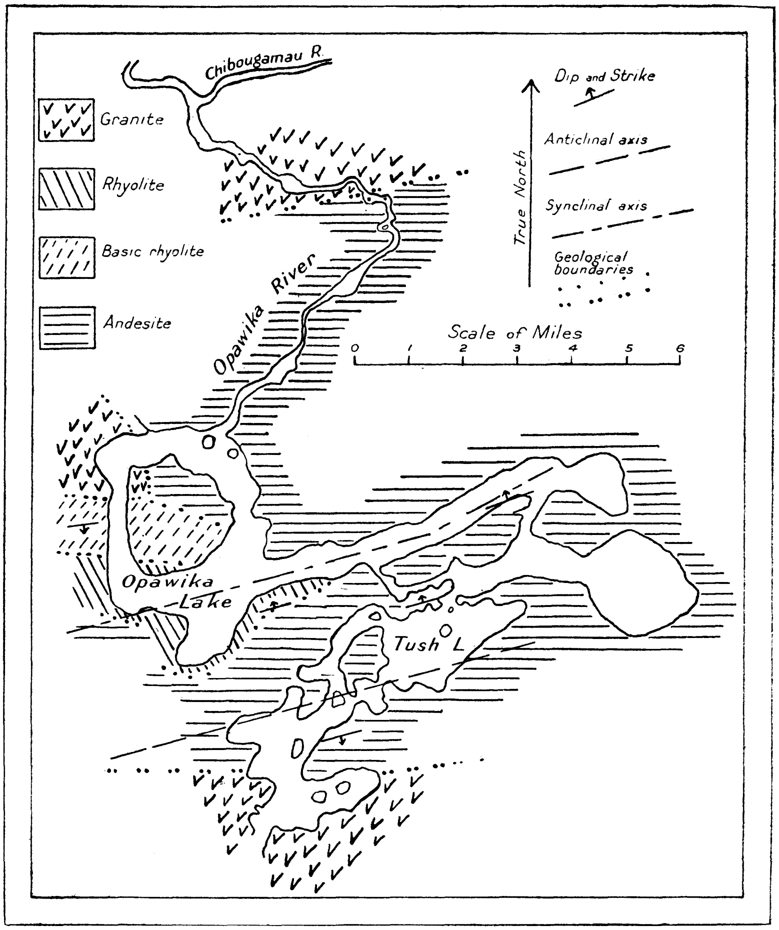

FIG. 4.—The Opawika area

It seems possible that the structure of this whole belt is that of a synclinorium, as the uppermost beds are found only near the the median line of the belt. However, this distribution may equally well be due to irregularity of original deposition, more especially as the rhyolite lava was probably viscous and did not spread out far from its vent.

Father's Lake area.—The structure of this small area appears to be that of a synclinal drag fold, although the lack of outcrops on the northwest side of the lake makes its complete determination uncertain (Fig. 5). The flows around the southern border of the area

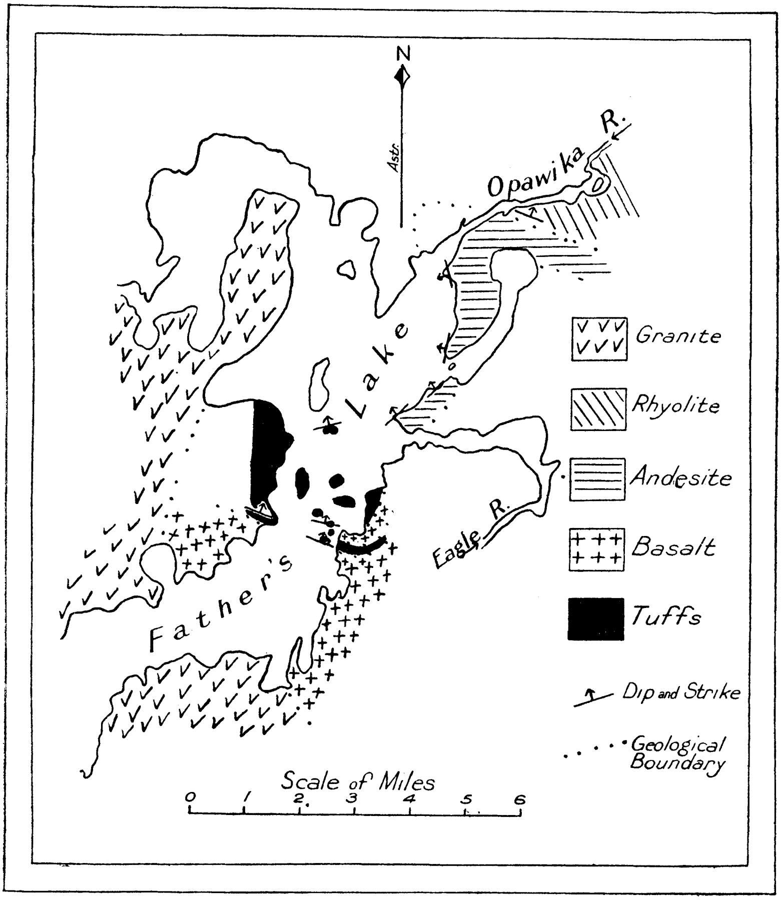

FIG. 5.—The Father's Lake area

are basaltic in composition and quite thin, some of them less than ten feet in thickness. Above them lie one or two flows of porphyritic basalt, characterized by feldspar phenocrysts up to one-half inch in diameter. Beds of basic sediments overlie conformably the porphyritic basalts and in one place are interbedded with them. The beds approximate one inch in thickness, and the thickness remains uniform over the outcrops, which in some cases were exposed two hundred feet or more along the strike. The sediments are of tuffaceous composition and vary from grayish or reddish cherty rock, which may be in part a deposit from silica-bearing solutions accompanying the lava flows, to black hornblendic material, probably recrystallized volcanic dust. In places they are filled with lenses of gabbroid material averaging about four inches in length by one-quarter inch in width.

North of the mouth of the east bay into which the Eagle River empties, outcrops of andesite occur, with a northeast strike and a dip to the northwest. The strike swings gradually to the north, then to the east at the mouth of the Opawika River, where they are overlain by rhyolite. It is doubtful what relation the andesites bear to the basalts and sediments. The mapping as it stands leads to the inference that faulting of some magnitude has taken place along the east bay into which Eagle River empties, but it is impossible to prove this, as the rocks here are all heavily drift covered. The map, however, is a rather inferior grade of track survey, and the impression gained in the field by assuming a projection along the strike was that the andesites overlie the basalts and part of the sediments and underlie the remainder of the sediments.

It may be observed that the basaltic flows in this area have no ellipsoidal textures, while the andesites are ellipsoidal. The significance of the fact will be discussed in a subsequent section. The succession in the Father's Lake area is

Rhyolite	Tuffaceous sediments
Andesite	Porphyritic basalts
	Basalts

Windy Lake–Nemenjish area.—The structure of the Windy Lake–Nemenjish (Fig. 6) area is monoclinal, so far as known, with a general east-west strike and a southward dip. This structure has been attained by strike faulting, with consequent repetition of outcrops. One large fault, whose south side was upthrown, was observed on Windy Lake, and possibly others occur to the south

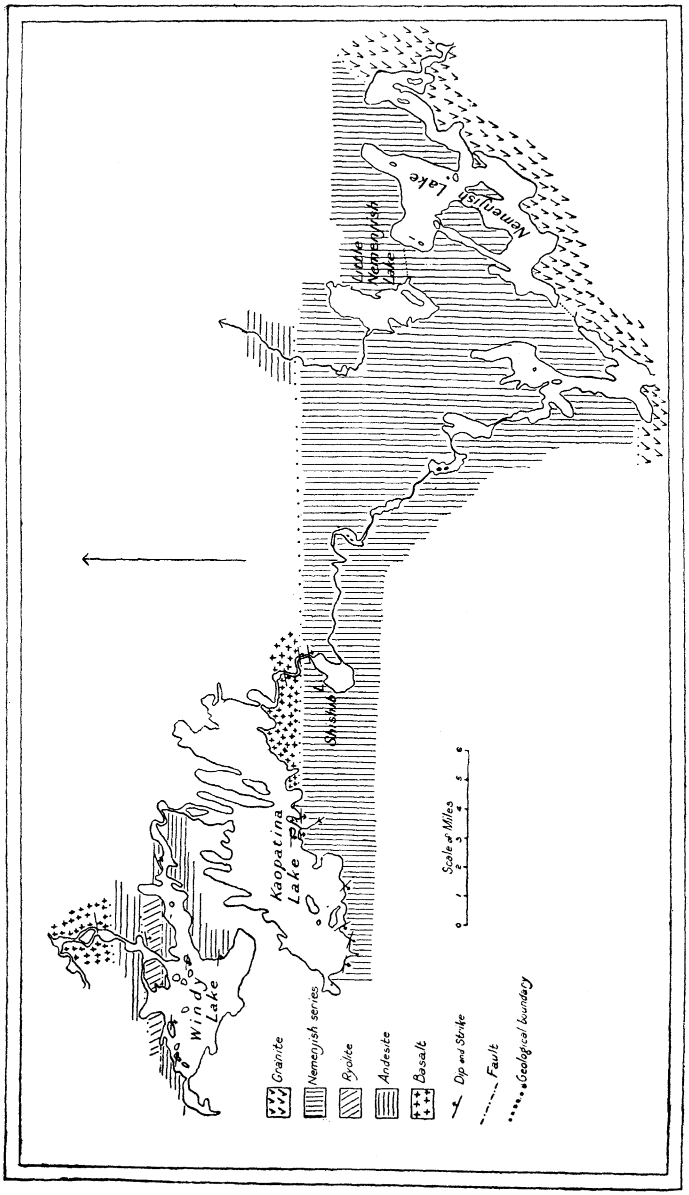

FIG. 6.—The Windy Lake–Nemenjish area

on Kaopatina Lake where most of the outcrops are hidden by a heavy cover of drift. The plunge of the folding appears to have been to the east, for near the west end of the area the strikes assume more of a north-south trend, which may indicate the presence of the axis of a cross-fold near-by, though it may be due merely to the subsequent disturbing influence of the granite intrusion to the west.

The basal rocks of the series, found on the river above Bras Coupe Lake, are very basic basalts, one flow of which is unusually fresh and glassy. These, like the basal flows on Father's Lake, possess no ellipsoidal structures. They are overlain to the south, as far as the outlet of Windy Lake, by andesites characterized by good pillow structures. A thin body of somewhat more acid lava lies above the andesites, and on this is found a bed of coarsely fragmental rhyolite, approximately 2,000 feet thick. Its composition is identical with that of the massive rhyolite porphyry on Opawika Lake. This fragmental rock shows no trace of bedding, as would a water-laid sediment, although we may conclude from the evidence of the pillow structure in the underlying andesites that the sea or a lake existed here at the time. It seems necessary to conclude therefore that the rock was not ejected as a tuff, but as a lava, and that its present fragmental condition is due to subaqueous extrusion, and hence corresponds to the pillow structure in the more basic lavas. Corroborative of this conclusion, rhyolite porphyry in the same fragmental condition was also found on Obatogamau Lake, where it rests directly on well-bedded tuffs, thus again indicating its subaqueous extrusion.

The southern boundary of the fragmental rhyolite is a fault, to the south of which the ellipsoidal andesites again outcrop.

Between the south shore of Windy Lake and the south shore of Kaopatina Lake the structure is unknown, as outcrops are not numerous or large enough for its determination, although there are sufficient to indicate that the formation is continuous across the gap. However, since the outcrops on the south side of Kaopatina Lake are of the basalts of the series, which elsewhere always occupy a basal position, and since they still maintain an east-west strike and a dip to the south, the intervening drift-covered gap must be supposed to be underlain by the south limb of a syncline whose north limb is found on Windy Lake, and by the crest of the next anticline; or else it must be assumed that another strike fault again upthrows the lower beds on the south.

The determination of the attitude of the beds on the south side of Kaopatina Lake, the correctness of which is a matter of great importance, was made with the greatest care in three different places, in each case by tracing a flow from its coarse-grained base up to its fine-grained top, where it was found in contact with the coarse-grained base of another flow. Lying above these basalts, and conformable on them, is a thick series of thin-bedded tuffs, interbedded with which, and rather high up in the series; is a thin flow of rhyolite porphyry. This flow is of small areal extent and appears only in the west end of the lake.

On the Opawika River above Kaopatina Lake the same relations were observed. Rather thick flows of basalt with a strike of N. 80° E. and a dip of 80° south are here conformably overlain by thin-bedded, rather basic tuffs. The plane of contact is occupied by a dyke of granite, which appears to be an offshoot of a larger mass to the east, as the dyke was not observed along the contact farther to the west, and where observed widens rapidly toward the east. The strike and dip of the tuffs is identical with that of the underlying basalt. About thirty feet above the contact a basalt flow about four feet in thickness is interbedded with the tuffs.

Passing higher into the tuffs toward the south, it was observed that the beds of tuff begin to be mingled with beds of metamorphosed clastic sediment. The latter become more numerous and finally replace the tuffaceous beds completely. At the same time the thickness of the separate beds increases until on the south side of Lake Shishib the beds are so heavy and massive that a bedding plane can rarely be observed.

The thick-bedded rocks on Lake Shishib are garnetiferous mica gneisses, probably recrystallized impure sandstones, or sandy shales. They continue to outcrop at intervals up the Opawika River to Dinachagama Lake, where they begin to be intruded by granite masses. They were traced across the Height of Land into Lake Nemenjish, on the north shore of which the sediments are well exposed and comparatively undisturbed by granite intrusion. Here the mica gneiss is interbedded with garnetiferous mica gneiss, hornblende gneiss, or amphibolite, garnetiferous hornblende gneiss, and crystalline limestone. The garnetiferous mica gneiss is identical in composition with the non-garnetiferous type, except for the presence of the garnets. The hornblende gneiss, or amphibolite, is a black, gabbroid rock, which may be of igneous origin, although no evidence of such origin could be obtained, and it is interbedded with the other rocks with perfect conformity. The garnetiferous hornblende gneiss is very similar to the non-garnetiferous type, with the addition of garnets; as in the case of the other, no evidence of an igneous origin could be obtained for it, and it is suspected that it may be a recrystallized, impure, calcareous sediment. In support of this view is the fact that the only crystalline limestone found, consisting of two beds, each about a foot in thickness, is interbedded with the garnetiferous hornblende gneisses.

This series of sediments has been named by the writer the Nemenjish series, from the lake on which it is best exposed.

The succession in these areas is therefore as follows:

Windy Lake Area	Kaopatina-Nemenjish Area
Tuffaceous sediments	Nemenjish series: Interbedded garnetiferous and non-garnetiferous mica gneisses and hornblende gneisses, with crystalline limestones
Rhyolite porphyry	Garnetiferous mica gneisses
Flows of intermediate composition	Interbedded mica gneisses and basic tuffaceous sediments
Andesites	
Basalts	Basalts

Eau Jaune–Obatogamau area.—This area includes Eau Jaune Lake and part of Obatogamau Lake (Fig. 7), together with a part of Presqu'ile Lake; but outcrops below Eau Jaune Lake are so scarce that the structure of this latter portion of the area could not be determined. The area is of interest mainly because of its conspicuous cross-folding. In the other areas described the axes of folding have a general east-west strike, and the cross-folding has been sufficient only to give these axes plunges varying from 15° to 30°. In the Eau Jaune area and, it may also be remarked, in the sediments on Nemenjish Lake, the cross-folding is as intense or more so than the folding along east-west axes. As these are the most easterly areas studied, it is not known whether the cross-folding represents merely a local crumpling along some plane of weakness or whether the areas are on the western edge of a region folded along northeast and southwest axes. A study of the reports and maps of the country to the east and north, however, makes the latter supposition seem probable.

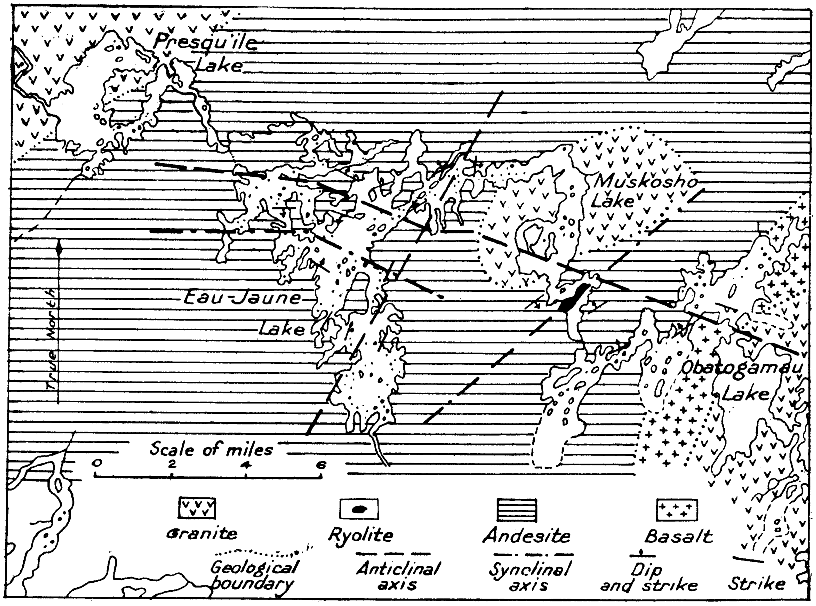

FIG. 7.—The Eau Jaune–Obatogamau area

The position and direction of the axes of folding are shown on the map. The one set, corresponding with those in the other areas described, strikes S. 70° E., apparently swinging in the western part of the area to east. The other set strikes N. 35° E. on Eau Jaune Lake, and N. 50° E. on Obatogamau Lake. The succession and distribution of beds suggest that the larger structure is that of a synclinorium whose axis has a northeasterly strike. The rocks on the eastern side of the area are basalts. Andesites overlie the basalts on the eastern side and outcrop also in the western part. Their composition gradually becomes more acid toward the center, and along the central synclinal axis there lies a small area of basic tuffs, overlain by twenty to thirty feet of fragmental rhyolite porphyry. The succession was well determined, and the distribution would indicate conclusively a general synclinal structure were it not suspected, as in the Opawika area, that the rhyolites are localized in their original distribution.

The best determinations of structure were made on the western part of Obatogamau Lake and the eastern part of Eau Jaune Lake, where the presence of large and easily determinable ellipsoidal structures rendered work easy. Time did not permit of the intensive work necessary for the determination of the structures of the basalts in the northern and eastern parts of Obatogamau Lake, while outcrops are rare along the eastern shores of Eau Jaune Lake.

The basalts of Obatogamau Lake are characterized by ellipsoidal structures, in contrast with the basalts of the areas to the west. The ellipsoidal structures in the basalts are small and difficult of recognition, except on unusually clean surfaces, so that they do not aid greatly in the determination of the attitudes of the flows. If this structure is an indication of submarine extrusion, however, their occurrence at this point will indicate that the seashore at the time of the basaltic extrusion lay between Obatogamau and Kaopatina lakes. From this point it must have transgressed rapidly westward as extrusion proceeded.

The succession as determined in this area is:

Rhyolite porphyry, fragmental
Andesite tuffs
Andesite flows
Basalt flows

Brock area.—The Brock area (Fig. 8) is situated at the confluence of the Brock and Chibougamau rivers. Unfortunately outcrops are poor in this locality on account of the cover of stratified sands extending up the Chibougamau valley.

The basal rocks are a series of basic lavas which are here more schistose than those farther to the south, presumably because of the shear between them and the overlying formation at the time of folding. Their structure was not determined. To the north of these is a series of sediments, which were found to form the south limb of a syncline, the north limb of which has been cut off by granite. At the southern contact of the series lies a heavy band of conglomerate. Only one outcrop of this was seen, about a mile below the mouth of the Brock River. At this point the conglomerate is very schistose. The pebbles are so numerous as almost to exclude matrix, which is a rather impure sand. About 30 per cent of the pebbles are hornblende granite; the remainder are various basic rocks, now so sheared that their original composition is indeterminable, although it is clear that they are of several kinds. The stresses to which the rock has been subjected have deformed the pebbles according to their original hardness. The softer have been converted into narrow strings several inches in length by a fraction of an inch in width; harder ones have been flattened into lenses the shape of which depends on the original hardness; while those of granite, the most resistant, have been deformed by fracture rather than by flow, and still retain much of their original shape. The softer pebbles have flowed around the harder, accommodating themselves most closely to all their curves. Fig. 9 illustrates this conglomerate. The almost undeformed granite pebbles are well shown; in some cases even the fractures in them, inclined at about 45° to the planes of schistosity, may be seen. Some of the more prominent pebbles of softer materials are also clearly visible, with the manner in which they have flowed around the harder granites.

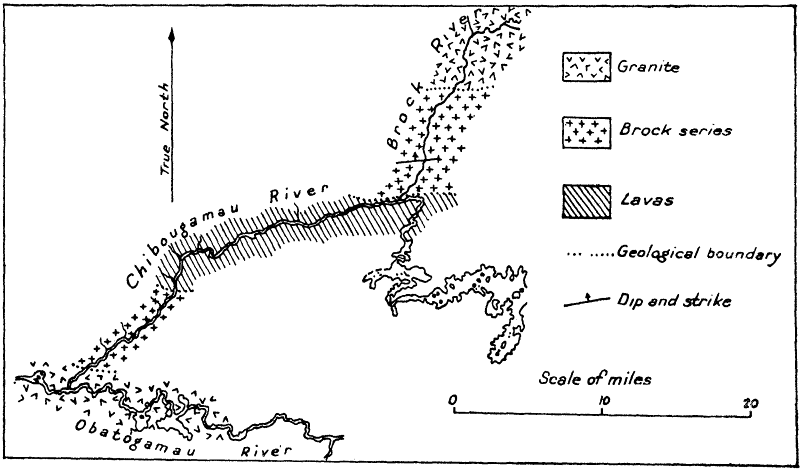

FIG. 8.—The Brock area

The rocks directly overlying the conglomerate are drift-hidden, but the next outcrops to the north are of mica gneiss and hornblende gneiss, which probably represent the recrystallized product of sandy shales. To the north of this, beds of altered impure sandstone and grit are found, beyond which mica and hornblende gneisses again appear. The latter rocks continue to outcrop to the northern limit of the area, where they are intruded and cut off by granite.

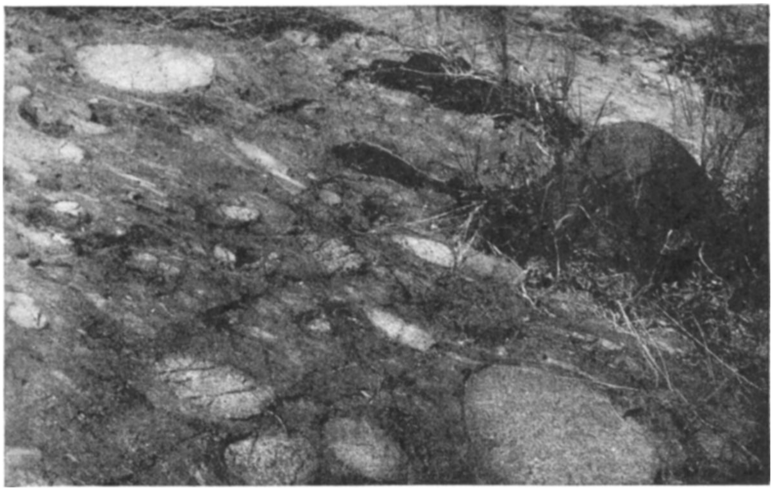

FIG. 9.—Conglomerate about a mile below the mouth of the Brock River

The rocks of the area were determined from observations on a number of drag folds, to form the south limb of a syncline or the north limb of an anticline. The axial planes of secondary drag folds were observed to dip toward the north. Hence the folding is of the abnormal type. The axes of these drag folds plunge, where observed on the Brock River, about 22° to the west. Hence the plunge of the primary fold at this point is to the west. The general strike of the axes of these drag folds is N. 80° to 85° E.

About twenty-five miles down the Chibougamau River, near the mouth of the Opawika, another wide area of rocks similar to the upper beds of this series of sediments outcrops. The basal conglomerate, however, was not found here, so that it is possible that these beds may not belong to this series, but may be fine-grained sediments of the Nemenjish series. The beds dip toward the north, but a consideration of the relative movement of the beds inferred from the shape of the drag folds showed that they form the south limb of an overturned anticline. It seems possible therefore that these beds are the south limb of the anticline of which the Brock sediments form the north limb. If so, the axial plane of this large fold dips to the north.

The succession in the Brock area therefore in order of age appears to be:

Mica and hornblende schists
Grits
Conglomerate
    Uncomformity
Green schists and basalts

Lucky Strike area.—The Lucky Strike area (Fig. 10) lies at and above the junction of Lucky Strike creek with the south branch of the Broadback River. Here, as in the Brock area, the youngest rocks are granites,. which intrude a series of sediments, consisting of conglomerate at the base, passing upward into arkose or greywacke, and then into muscovite schists which probably represent impure sandstone. Beds which may have overlain these have been cut off by the granite. All the beds are much deformed, although not so much as in the Brock area. The following pebbles were observed in the conglomerate: hornblende granite, quartz biotite schist, anorthosite (one only), hornblende schist, made up almost wholly of hornblende needles; hornblende schist containing 30 to 40 per cent plagioclase, quartz porphyry, bedded chert, and others which were originally of softer rock and are now so deformed as to render their original nature indeterminable. Many of these pebbles are recognizable as having been derived from the lava series, so that the conglomerate is evidently unconformable above it. The harder pebbles have suffered little or no deformation and are well rounded, indicating long attrition before deposition in their present position.

The older series is not well exposed in this locality. Directly underlying the conglomerate in one place is found a garnetiferous

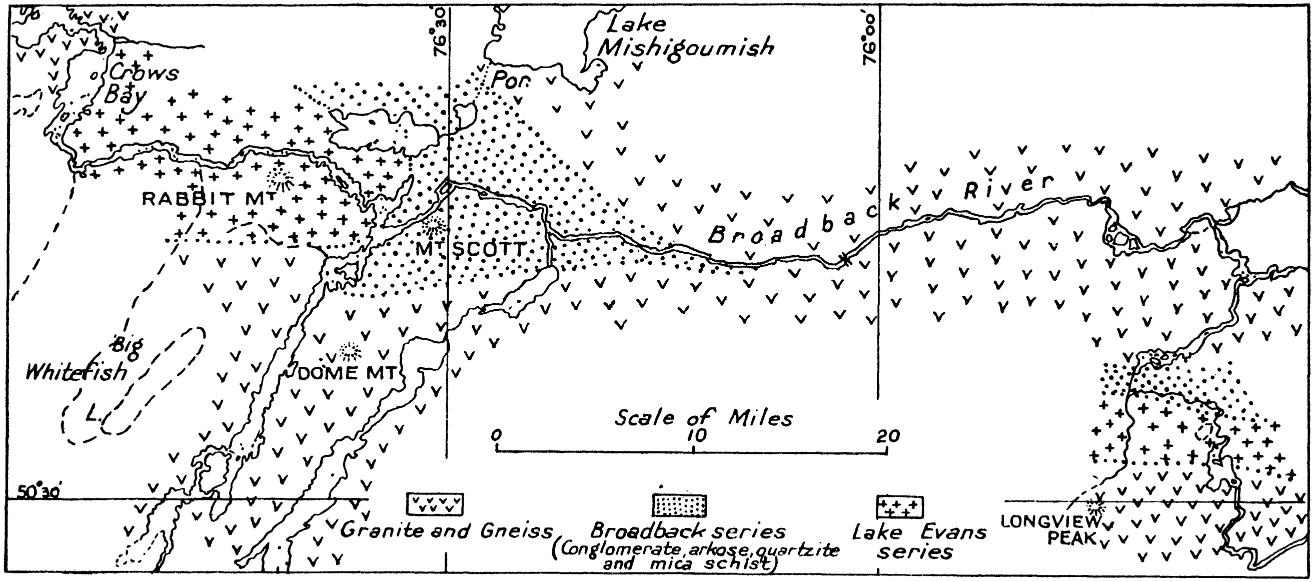

FIG. 10.—The Kenoniska area (about Mount Scott) and Lucky Strike area (north of Longview peak)

mica gneiss, identical in composition with the corresponding garnetiferous gneiss of the Nemenjish series on the Opawika River. Below this, in scattered outcrops, were observed basalts, basic intrusives, tuffs, and carbonate schists.

The succession in this area is therefore:

Broadback series, sandstone, now muscovite schist, arkose or greywacke, conglomerate
Unconformity
Nemenjish series, garnetiferous mica gneiss
Basic intrusives, basalts, tuffs, carbonate schists

Kenoniska area.—This area (Fig. 10) lies at the north end of Kenoniska Lake, on the Broadback River. It was mapped in part during the work of 1912. The map published at that time included the results of information gained by an earlier observer, which re-examination by the writer in 1914 proved to have been incorrect. As a result the formation boundaries shown on the map of 1912 are not to be accepted as final.

The geologic section in this area is very similar to that found in the Lucky Strike area, but is of more value, partly because the section is better exposed and more complete, and partly because undeformed rocks are to be found. The structure of the area is that of an anticline about ten miles in width, both limbs of which are cut off by granite. The anticline plunges to the east. The rocks on the limbs are very much sheared, but at the crest of the anticline, which is seen about five miles above Kenoniska Lake, the shearing has been so slight that even the slightest foliation can barely be detected.

The uppermost series, which was termed the Broadback series by the writer in 1912, consists of sediments which lie unconformably on an older series consisting mainly of lavas. At the base of the sedimentary series there are two heavy bands of conglomerate, separated by a thick band of fine-grained greywacke containing occasional pebbles. Above the conglomerate occur in order arkose, a thin band of quartzite, and mica schist. The latter includes both muscovite and biotite schists, of which the biotite schists are the larger in amount. The muscovite schists are probably the metamorphosed equivalent of very siliceous shales, the biotite schists of less siliceous shales.

The conglomerate on the limbs of the fold has been so sheared as to deform all the pebbles, as in the case of the conglomerate described in the Brock area. At the nose of the anticline, however, the rock is undeformed. The number of pebbles is so great that very little of the greywacke matrix is observable. The majority are unusually well rounded and of all sizes, up to eight inches in diameter. The material is very poorly assorted and markedly cross-bedded. The variety of the pebbles is great. About 50 per cent of the total number are of light-colored biotite granite; a few, about 4 or 5 per cent, of a still more siliceous granite, with almost no ferromagnesian mineral; 10 to 15 per cent consist of dark, bluish chert, often banded; while the remaining 30 per cent are quartz and various basic rocks, hornblende schist, andesite, etc., most of which can be matched in the lavas below.

The underlying series, which was named the Lake Evans series in 1912 consists near the base of basalts overlain by porphyritic andesites. Some thin-bedded, fine-grained, slaty tuffs were found overlying the andesites on Storm Lake; probably overlying these tuffs, and directly underlying the Broadback conglomerate, are some thin beds of garnetiferous mica gneiss, petrographically similar to certain of the members of the Nemenjish series. The structure of these rocks could not be worked out in detail on account of lack of outcrops, but the strike and dip of the bedding, wherever observable, is approximately parallel to the bedding of the overlying Broadback sediments.

As already stated, the general structure of this area is that of an anticline, whose axis has a strike of S. 75° E., and a low plunge to the east. If the axis of this fold be projected eastward across the intervening granite area, it is found to pass through the Lucky Strike area; so that these two areas probably form the two limbs of a large synclinal cross-fold, whose axis strikes N. 15° E. If so, the plunge of the Lucky Strike anticline, which was not determined in the field, must be toward the west.

The succession in the Kenoniska area therefore is:

Mica schist
Quartzite
Arkose
Conglomerate
Unconformity

Nemenjish series (?) garnetiferous mica schist
Slaty tuffs
Andesites
Basalts

Mattagami area.—This area (Fig. 11), which lies on Mattagami Lake, has been briefly examined by the writer, but has been studied in detail by J. A. Bancroft.[1] The following is a summarized description of the more important points of composition and structure described by him.

The rocks include, as in the three foregoing areas, an overlying sedimentary and an older lava series. The sediments have been named by Bancroft the Mattagami series. They form a belt underlying the bed of the lake which outcrops at intervals along its shores over a distance of about fifteen miles. They consist almost wholly of quartz biotite schists, which are probably the metamorphosed equivalent of impure sandstones; these pass into conglomerate in places by the addition of pebbles of all sizes up to six inches in diameter. The pebbles are always scattered, never crowded together as in the conglomerates already described. However, it may be that if the series were better exposed bands of the more characteristic conglomerate would be seen. The deformation has been so great that all the pebbles with the exception of the hard granites have been squeezed, flattened, and in many cases reduced to narrow strings; while even the granites have been much granulated and recrystallized. On this account the recognition of the

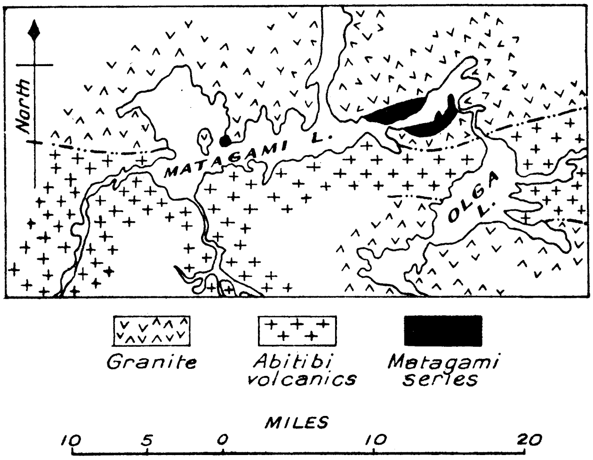

FIG. 11.—The Mattagami area

---

[1] *Report on Mining Operations*, Quebec, Department of Colonization, Mines, and Fisheries, 1912, p. 131.

original nature of the pebbles is difficult. About 60 to 70 per cent of them are of granite; the remainder includes diorite, aplites, and biotite and hornblende schists.

Bancroft considers these sediments as probably unconformable on the series of lavas that lies to the south. The structure is difficult to determine, as the granite intrusions have cut off the sediments to the north, and have stoped their way to the lavas. Bancroft is of the opinion that the structure is that of a tight syncline; however, it appears equally probable that the present band represents only the south limb of a syncline, whose north limb has been cut off by granite. The writer inclines to the belief that the structure of the whole belt between Mattagami Lake and the National Transcontinental Railway is a great anticlinorium, the Mattagami series of sediments representing the north limb, the sediments of the Pontiac series the south limb. This theory, however, is unsupported by facts other than the petrographic resemblance of the sediments of these two groups and a general parallelism in their strike. It can probably never be proved by field evidence, as outcrops over the intervening territory are too small and scattered to make any continuous determination of structure.

To the south of the Mattagami series lie the supposedly older rocks, consisting of lavas, intrusives, and tuffs. The lavas include andesites and basalts principally, some of them distinguished by beautiful ellipsoidal structures. Slaty tuffs were observed in a few places. The strike of these rocks, where observed, is in general east-west, like that of the overlying sediments. The most important intrusive in the vicinity of Mattagami Lake is a large body of very coarse, feldspathic gabbro, petrographically identical with the gabbros which in other localities have been observed to grade into anorthosites, and probably to be correlated with them. It intrudes the lava series, but does not ascend as high as the contact with the sedimentary series; hence its relation to the sedimentary series is indefinite.

The succession in the Mattagami area therefore appears to be:

Mica schists
Conglomerate
Uncomformity

Basic intrusives
Basalts, andesites, rhyolites, and tuffs

Pontiac area.—The Pontiac area (Fig. 12) lies far to the south of the Brock, Broadback, and Mattagami areas but its rocks are strikingly similar. It is found to the south of the National Transcontinental Railway with its western end close to the Ontario-Quebec boundary; it is nearly one hundred miles in length by twelve in breadth. The rocks have been studied by M. E. Wilson[1] and J. A. Bancroft.[2] The following is a summarized account of their descriptions.

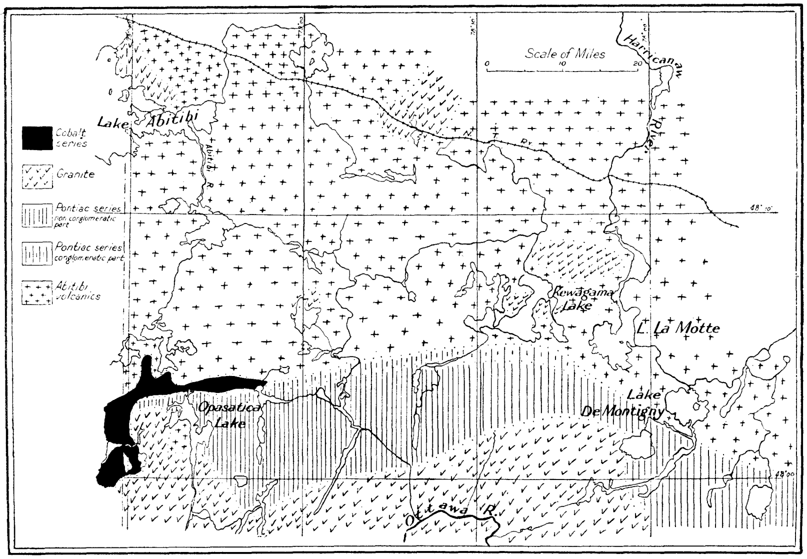

FIG. 12.—The Pontiac area

The rocks of the region fall into two general classes, a volcanic complex and a series of metamorphosed clastic sediments, termed by Wilson the Pontiac series. The Pontiac series is cut off on the south by intrusions of granite; the volcanic complex lies to the north of it. The band of sediments averages ten miles in width; the major part of this, about nine miles, is underlain by mica schist, with which is associated some hornblende schist and amphibolite.

---

[1] *Geol. Surv. Can.*, Mem. No. 39, 1914.

[2] *Report on Mining Operations for 1911*, Department of Colonization, Mines, and Fisheries, Quebec, p. 160; 1912, p. 199.

Toward the northern edge mashed arkose, greywacke, and conglomerate are found. The mica schist is a fine-grained rock consisting essentially of quartz and biotite usually with some feldspar. The arkose and greywacke are of much the same composition, though coarser in grain; they differ from each other only in the relative proportions of acid and basic fragments they contain. Both pass into conglomerate by the gradual addition of pebbles.

The composition of the conglomerate apparently varies a great deal from place to place. Wilson states that in the more western portions of the area studied by him he found pebbles only of granite, rhyolite, and quartz porphyry and none of the more basic rocks. Bancroft, on the contrary, working in the more eastern parts of the area, reports the majority of the pebbles to be of greenstone, although pebbles of granite and diorite are not uncommon. Metamorphism has squeezed and flattened all the pebbles more or less, converting the softer of them often into mere strings.

The Pontiac series overlies the volcanic complex unconformably according to Bancroft, as most of the pebbles of the conglomerate can be matched in the rocks below. Wilson, who did not find outcrops containing the more basic pebbles, doubts the uncomformity and is inclined to believe that the sedimentary series is older than the volcanic, since the general dip is steeply to the north. To secure further evidence, if possible, on this question in dispute, the writer visited Lake de Montigny in 1917 to examine the contact there. The contact itself has been exposed here in workings of some prospectors, and the lavas to the north are well exposed. The examination by the methods outlined in the beginning of this paper indicated that the south side of the flows is the uppermost. This evidence therefore confirms Bancroft's conclusion that the sediments overlie the flows, and some further support to it is given by the similarity of the Pontiac series to the Brock and Broadback series, both of which are undoubtedly younger than the volcanics. The northward dip must be ascribed to overturned folding.

The general trend of the strike of these rocks is east-west, and the dip, as stated, steeply north. Bancroft is inclined to believe that they form a tight syncline, but against this hypothesis lies the fact that the conglomerate member is found only on the north side of the band of sediments. It seems more probable that they form the north limb of a syncline, whose south limb has been stoped off by the granite, while its anticlinal continuation to the north has been removed by erosion. If this is the case, the axial plane of this syncline must dip to the north.

Both Wilson and Bancroft have described all the sediments as parts of one sedimentary series. Since their work was published, however, several facts have come to light which are difficult of explanation if the rocks are to be considered as a single series, while the fact that outcrops are exceedingly poor in this district, owing to the heavy cover of glacial lake clays, renders it possible that two or more series of metamorphosed sediments have been inadvertently grouped together. The facts which tend to throw doubt on their interpretations are:

1. On Lake de Montigny, at the contact of the Pontiac series and the underlying greenstones, no conglomerate is found. The basal beds of the sedimentaries are dark mud rocks of the composition of a basic greywacke. Conglomerate does not occur here. Wilson describes the conglomerate as occurring in discontinuous patches. In the series of younger sediments to the north, already described by the writer, the conglomerate band at the base of the younger sedimentary series is always thick, strong, and continuous.

2. Wilson describes amphibolites occurring interbedded with the mica schists of the Pontiac series in places. Amphibolites were not observed by the writer to form part of any of the younger sedimentary series in any of the areas studied by him; they are, however, very characteristic of the Nemenjish series and form a considerable proportion of it.

3. Wilson[1] found outliers of the Grenville series (which, it will be shown, is probably correlative with the Nemenjish series) on Grand Lake Victoria, about twenty-five miles south of the most eastern outcrop of the Pontiac series. Bancroft[2] in 1916 found outliers of the Grenville series as far west as Doucet, some thirty miles

---

[1] *Geol. Surv. Can., Sum. Rept.*, 1912, p. 337.

[2] Personal communication

east of the most eastern outcrop of the Pontiac series. The intervening distance has not been closely examined. It seems strange that the Grenville series should approach the Pontiac so closely and yet not be found within the Pontiac area, and that so widespread a series as the Pontiac should end so sharply, and no further trace of it be found included in the granites to the south or east. Both these difficulties would at once disappear, however, if at least a part of the Pontiac were identical with the Grenville series.

4. To the north of the main belt of the Pontiac series Wilson has mapped several minor areas of sediments surrounded by the Abitibi volcanics. They are of mica schist only, without the conglomerate member. If the conglomerate and all the mica schists form a part of the same series, the conglomerate member should appear in these areas also, along the line of contact of the greenstones and the sediments.

In view of these facts the writer tentatively advances the view, alternative to that suggested by Wilson and Bancroft, that the so-called Pontiac series consists of two sedimentary series. The older, composed mainly of mica schists and amphibolites, is equivalent to the Grenville and Nemenjish series and may lie upon the older volcanic series conformably. The younger contains the conglomerate, arkose, and greywacke members, and perhaps a portion of the mica schists, and may be equivalent in age to the Mattagami, Broadback, Lucky Strike, and Brock series.

The rocks of the volcanic complex underlying the Pontiac series consist mainly of lavas varying in composition from basalt to rhyolite; the types of intermediate composition are the most common. Interbedded with them are small amounts of slate or slaty tuff, and dolomite, which in part at least is an altered rhyolite. Intrusive into these rocks are bodies of gabbro and diabase. All of the rocks have undergone more or less metamorphism and have been converted locally into schists. Outcrops throughout the area are too sparse to determine structure and succession, but wherever strikes are determinable they have a general east-west direction.

Summary.—The geological sections described in the foregoing areas may be summarized as follows:

Pontiac Area

Mica schist
Arkose, greywacke
Conglomerate
  Unconformity
Basalt, andesite, rhyolite, tuffs, and intrusives

or

Mica schist
Arkose, greywacke
Conglomerate
  Unconformity
Mica schist and amphibolite
Basalt, andesite, rhyolite tuffs, and intrusives

Matlagamie Area

Mica schists
Conglomerate
  Uncomformity
Basic intrusives
Basalts, andesites
Basalts, andesites, rhyolites, tuffs

Kenoniska Area

Mica schists
Quartzite
Arkose
Conglomerate
  Unconformity
Garnetiferous mica schists
Slaty tuffs
Andesites
Basalt

Lucky Strike Area

Mica schist
Arkose, greywacke
Conglomerate
  Unconformity
Garnetiferous mica schist
Tuffs, basalts, basic intrusives

Brock Area

Mica and hornblende schists
Grits
Conglomerate
  Unconformity
Basalts and schists

Windy Lake Area

Tuffaceous sediments
Rhyolite porphyry
Flows of intermediate composition
Andesite flows
Basalt flows

Kaopatina–Nemenjish Area

Interbedded garnetiferous and non-garnetiferous mica gneisses and hornblende gneisses, with crystalline limestones
Non-garnetiferous mica gnesises
Interbedded mica gneisses and basic tuffaceous sediments
Basalt flows

Eau Jaune–Obatogamau Area

Fragmental rhyolite
Andesite tuffs
Andesite flows
Basalt flows

Father's Lake Area

Basic tuffs
Andesite flows
Porphyritic basalt flows
Basalt flows

Opawika Area

Rhyolite flows
Intermediate lavas
Andesite tuffs
Andesite flows

[*To be continued*]